Salt Structure and Sediment Thickness, Texas-Louisiana Continental Slope, Northwestern Gulf of Mexico

By

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Abstract

The objectives of this study were to determine the general configuration of the salt surface beneath the Texas-Louisiana continental slope and to isopach the Mesozoic-Cenozoic sedimentary section lying upon it.

The structure contour map discloses that the entire slope province between the shelf edge and Sigsbee Escarpment is underlain by salt structures which interconnect at relatively shallow subbottom depths. Salt structures on the slope south of Louisiana and eastern Texas can be grouped according to structural relief and size which define morphological belts of decreasing deformational maturity in a downslope direction. Off northern Mexico and southernmost Texas, salt structures are anticlinal and their trends suggest a structural relationship with the folds of the Mexican Ridge province to the south. Structural trends in the two slope areas meet in the corner of the northwestern gulf where salt structure may have been influenced by a seaward extension of the San Marcos Arch, or an abrupt change in subsalt structural topography.

Sediment thickness above the top of salt on the slope averages about 1,400 m (4,620 ft) which is a smaller average than expected from previous estimates. In some synclinal basins between salt structures, sediments

may be as thick as 4,000-5,000 m (12,000-17,000 ft). On the average, sedimentary deposits in basins on the upper slope are thicker than on the lower slope. From the isopach map of sediments above salt it is estimated that the U.S. continental slope off Texas and Louisiana contains a sedimentary volume of about 170,000 km^3 (41,000 mi^3). The bulk of this volume is situated in synclinal basins between domes and principally in those beneath the upper and middle slope regions.

Introduction

The continental slope off Texas and Louisiana encompasses an area of more than 119,500 km^2 (46,000 mi^2) that is underlain by large masses of salt which protrude upward and nearly crop out on the sea floor. They produce some of the most intriguing sea floor topography of all the U.S. continental margin and constitute a distinct structural province, referred to as the Texas-Louisiana slope, that lies in water depths ranging from about 200 m (656 ft) to 3,000 m (9,840 ft) along the base of the Sigsbee Escarpment. The Texas-Louisiana slope is considered to be the seaward flank of the Gulf Coast Geosyncline. The presence of large salt structures, thick sedimentary deposits in synclinal basins, and the proven oil and gas resources of the adjacent shelf area indicate that the Texas-Louisiana slope may be an important region of future energy resources.

During the period 1969-1971, the U.S. Geological Survey and the U.S. Naval Oceanographic Office, in both cooperative and independent investigations, recorded more than 16,483 km (8,900 n mi) of single-channel seismic profiles along the ship's tracks shown in the index map (fig. 1). The density of data coverage, accuracy of navigation and quality of the seismic records permit a reconnaissance mapping of the structure on top of salt and the thickness of the overlying sedimentary sequence.

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Previous Investigations

The submarine topography of the Texas-Louisiana slope (fig. 2) with its seaknolls, terraces, depressions, steep-walled valleys, and Sigsbee Escarpment has intrigued geologists for many years. Although the average slope for this vast province is slightly less than 1° (92 ft/mi) (Shepard, 1963), local relief is commonly as much as 600 ft/mi (108 m/km). Gealy (1955) aptly described the slope topography as "hummocky", but suggested that it had resulted from submarine landslides, sediment creep, and turbidity flow. Shepard (1937) and Carsey (1950) had earlier speculated that the submarine hills on the upper slope were the sea floor expression of salt domes. Moore and Curray (1963), however, were the first to show the existence of diapiric structures which they interpreted as being either salt or shale beneath the upper slope. Ewing and Antoine (1966) suggested a continuous belt of diapiric structures extending from the Texas-Louisiana coastline to the Sigsbee Escarpment which they interpreted as being the front of the system of salt structures.

Although little doubt as to the nature of the diapiric structures existed after the publication of reflection profiles by Moore and Curray (1963), Ewing and Antoine (1966) and Emery and Uchupi (1968), the presence of salt in the slope was not physically proven until Lehner (1969) reported that salt was penetrated in core holes on 10 structures on the upper and middle Texas-Louisiana slope.

From more recent investigations across the Texas-Louisiana slope, reflection profiles recorded aboard the vessels USNS Kane (USGS-NAVOCEANO, 1969), USNS Keathley (NAVOCEANO, 1970), R/V Cadette Virgilio Uribe (USGS-Mexico, 1970) and R/V Unitedgeo I (USGS, 1971), it has been learned that the extent of salt domes includes the entire continental slope province from off the Mississippi Delta southwestward into the continental margin of northern Mexico and perhaps continuously into the southern Gulf of Mexico. Along the foot of the Texas-Louisiana slope the salt structures abruptly terminate to form a wall of salt which underlies the Sigsbee Escarpment. Along most of the length of the escarpment and at the foot of the slope off south Texas and northern Mexico the salt wall apparently is in near-vertical contact with sedimentary layers of the continental rise and abyssal plain. DeJong (1968) and Amery (1969) have reported the apparent overflow of salt onto these beds along part of the escarpment south of the Louisiana coast.

Present Study

Seismic reflection profiles recorded aboard the USNS Kane and Keathley (fig. 1) provided the principal data used in this report; Kane profiles were made using a 160-kilojoule sparker and Keathley records using a 60-kilojoule sparker. These data were supplemented with 160- and 120-kilojoule records from the Unitedgeo I and Uribe surveys. The ships' positions were determined from satellite navigation for the Keathley and Unitedgeo I and Loran-A and C for Kane and Uribe. Maximum positional errors are thought to range between 500 and 1500 m with the best agreement between position and bottom topography being achieved along Keathley tracks.

In construction of the contour maps (figs. 3 and 4), the top of salt was assumed to be approximated by either a strong reflector or a zone of diffraction patterns having a pillowy surface below which no coherent reflectors were recorded. The depth to top of salt and the thickness of overlying sediments were measured in seconds of reflection travel time (two-way) at 15-minute intervals along the profiles with intermediate readings at prominent peaks or troughs on the salt surface. Sediment thicknesses cited throughout this report refer to the stratified section above the assumed top of salt. Because of the uncertainty of sediment velocities on the slope, the maps were contoured in seconds of reflection travel time rather than in meters based on an assumed average velocity. These measurements were plotted along the ships' tracks and contoured at the scale of figures 3 and 4. Sediment thicknesses cited in the text were estimated from the velocity structure given in Table 1.

It should be noted that the reflector, or zone of reflections, assumed to be top of salt may in many cases represent caprock or shale masses which commonly accompany Gulf Coast salt domes. Thus, the structural contours in figure 3 should be considered as the approximate configuration of salt masses, and the isopach values in figure 4 as minimum sediment thickness above the assumed salt surface.

Sediment thickness and depth-to-salt between steep-flanked domes may also be considered minimal figures. In many cases the conventional acoustical signature of a salt surface could not be detected on profiles between steep-flanked domes, so measurements were made to projected intercepts of the flank reflectors. Fault symbols on the structure map are used to show apparent linearity and continuity of steep flanks of several salt structures within the continental slope province and to delineate the apparent near vertical and overflow nature of the salt front along the Sigsbee Escarpment. Fault trends in the overlying sediment section were too complex to map with any degree of certainty from the profile spacing available for this study.

Structure on Assumed Top of Salt

The structure map shows that although relief on the salt surface is complex, it slopes generally basinward from the shelf edge. Landward beneath the shelf, the salt surface is known to slope toward the Texas-Louisiana coast where, according to Lehner (1969, fig. 43), it may lie as deep as 15.2 km (50,000 ft). The results of this study indicate that the surface of the salt layer between domes on the upper slope generally lies at a depth of only 2.5-3.0 km (8,000-10,000 ft). The thickness of salt on the Texas-Louisiana slope and the nature of the rocks beneath it is unknown, but it is apparent that the subsalt material and the salt structures of the continental slope form a geanticline which flanks the Gulf Coast Geosyncline on the south, separating it from the deep gulf basin.

Beneath the Texas-Louisiana Shelf salt domes commonly shaped like slender columns have pierced many thousands of feet of sedimentary material to reach or nearly reach the seafloor (Lehner, 1969; Garrison and Martin, 1973). In the coastal plain and under the shelf, salt domes range from about 1.6-16 km (1 to 10 mi) wide, but domes more than 8.0 km (5 mi) across appear to be the exception. In contrast, salt structures on the slope tend to be in the form of broad stocks and swells whose diameters range from 5 to 25 nautical miles (9.3-46.0 km) and whose crests rise only a few thousand feet above their bases. Lehner (1969) and Garrison and Martin (1973) have subdivided the Texas-Louisiana slope into upper and lower zones based on the differences in salt structures and thicknesses of stratified deposits revealed in reflection profiles. Garrison and Berryhill (1970) reported that sediment filled basins on the lower slope were more or less perched on the salt mass rather than having been intruded by it. The results of this study support their conclusions.

Within the Texas-Louisiana slope province, contrasts in the structural forms of salt domes exist between the upper, middle, and lower slope areas and between the diapirs south of Louisiana and Texas and those on the slope off southernmost Texas and northern Mexico (fig. 5). Salt structures on the uppermost slope between the 200- and 600 m contours commonly are small, plug-like masses having diameters of 7.4-13 km (4-7 n mi) and generally rising 2.0-2.5 sec (2.2-3.0 km) above a common base level of interconnection. Relief on the salt surface in the middle-slope region (600-1400 m water depth) off eastern Texas and Louisiana is about the same as that for the upper-slope diapirs, but structures there are generally elongate masses with NW-SE and N-S trends. In profile view, these structures appear as flat-topped, steep-flanked massifs separated by depressions filled with thick, bedded deposits. Often these structures have coalesced to surround deep topographic depressions containing thick sedimentary sections. In marked contrast to the structure of salt domes of the middle and upper slope, the salt surface under the lower slope, principally south of Louisiana, forms large swells 28-46 km (15-25 n mi) across, which rise about 1.0-2.0 sec (.95-2.2 km) above their bases. Salt swells on the lower slope trend NE-SW, and are separated from one another by broad structural depressions filled nearly brim-full with sediments.

Within each of these zones of similar salt structures (fig. 5), the crests of domes lie at common elevations. On the upper slope, most salt tops appear to be defined by closures of the 1.0 sec contour. In the middle-slope region, salt crests lie at depths of about 2.0 and 2.5 sec, whereas the salt swells on the lower slope generally crest at depths of 3.0 to 3.5 sec. It is believed that the belts of common crestal elevation are mainly related to the seaward slope of the main salt layer from which the structures rise and to the structural maturity of the belts. Lehner (1969) observed that the salt pillows of the lower slope region represent an early stage of tectonism where broad sedimentary basins subsided into a salt mass, laterally displacing the salt away from the centers of subsidence. As the differential load of the overburden was increased with the addition of sediments to the subsiding troughs, the salt mass was squeezed into narrow swells and massifs. Eventually as the basins were filled and sediment load increased higher and higher on the flanks of structures, the salt was deformed into stocks or pluglike structures similar to those that are common on the upper part of the slope, and ultimately into the slender salt chimneys and mushroom domes that dot the inner shelf and coastal plain. Thus, the belts of structural forms along the Texas-Louisiana slope appear to conform to definite stages of salt tectonism. Belts of equal crestal elevation would seem to indicate uniformity of sediment load within the individual structural belts.

The salt structures of the Texas-Louisiana slope terminate abruptly at the steep salt-front under the Sigsbee Escarpment from near lat 27° N. on the east to Alaminos Canyon on the west. Seismic reflection profiles across the scarp show that it is underlain by a near-vertical wall of salt along most of its length. In the salient where the scarp trend lies south of lat 26° N., deJong (1968) and Amery (1969) have reported evidence of salt extrusion onto sedimentary deposits that appear to correlate with relatively young beds of the continental rise. Similar evidence from profiles used for this study show the amount of lateral salt extrusion to be generally less than 10 km. The vertical or near-vertical attitude of the salt wall seen elsewhere along the Sigsbee scarp in the reflection profiles may be misleading. In the area of observed overflow, the salt mass is only several hundred meters (several tenths of a second) thick; in Amery's (1969) reconstruction, thickness of the salt tongue ranges from 400 to 1700 m. It may be that the salt mass elsewhere along the scarp also overflows abyssal beds, but that the distance of overflow is small and that the thickness of the salt mass is great enough to acoustically mask any evidence of underlying beds.

In the western area of the slope province from the abrupt bend in the continental margin near long 94°30' W. southward to northern Mexico, the structural complexity of the salt is considerably less than that to the east. In this area of structural transition, convolute anticlinal trends of the western slope meet the complex, arcuate trends of the northern slope along an apparent NW-SE lineament (fig. 5). The trend and position of this transitional boundary is coincident with the proposed seaward extension of the San Marcos Arch of Garrison and Berryhill (1970). They noted that this area of the slope is less densely populated with diapirs than that to the east or south and suggested that the arch, which separates the Gulf Coast Salt Dome Province onshore from widely disseminated diapirs in South Texas and northern Mexico, may continue seaward and similarly influence the salt dome province on the slope. Furthermore, they reported that seismic profiles across the southern half of this zone disclose a wide area of the slope underlain by a gently undulating, nearly horizontal salt-surface, covered by only a thin layer of sediments. The sparce distribution of diapirs in this area may be due mostly to insufficient sedimentary loading necessary to produce the complex deformation patterns common elsewhere on the slope. It is also possible that the salt layer in this area is too thin to respond diapirically in the same degree as in the adjacent slope regions (Garrison and Berryhill, 1970). The rather abrupt change of structural trends along the San Marcos Arch extension appears to be real and may represent an equally abrupt change in subsalt structural topography.

The parallelism of regional trends between the salt structures south of lat 26° N. and the sedimentary folds in the Mexican Ridge Province to the south suggests a structural relationship between the two regions. Whether the sedimentary layers in the Mexican Ridge Province have been folded over growing salt anticlines or whether the deformation patterns of the ridge and salt provinces are simply related to the same tectonic forces or underlying basement configuration is presently unknown.

Sediment Thickness

The isopach map (fig. 4) shows a close correspondence between sediment patterns and salt structures across the entire slope as might be expected. In synclinal basins between domes, sediments appear to be about 2,000 m (7,000 ft) thick on the average. Sedimentary deposits in excess of 3,500 m (12,000 ft) are restricted to basins on the upper slope, along the foot of the Sigsbee Escarpment, and along the base of the slope off northern Mexico.

Basins between domes on the upper slope contain an average of 2.0-2.5 sec (2.2-3.1 km) of sedimentary fill, as do basinal areas on the middle slope which is consistent with the observation that domes in both zones have about the same amount of structural relief. The tendency for domes to be smaller and more equidimensional on the upper slope probably results from greater loading by thicker sedimentary sections situated beneath the adjacent shelf area. On the lower slope where the salt has been deformed into broad swells in a relatively young state of salt tectonism, sedimentary basins contain an average thickness of only about 1.5 sec (1,630 m) of sedimentary fill.

On the western slope off South Texas and northern Mexico, the sedimentary section thins toward the foot of the slope and then abruptly thickens into the abyssal plain. As in the eastern part of the salt province, structural crests are topped by only about 0.5 sec (473 m) of sedimentary material. Basinal deposits commonly exceed 1.5 sec (1,630 m) in thickness. Broad areas of the slope in the northwest corner of the gulf margin are covered by relatively thin (1.5 sec; 1,630 m) sediments, thus reflecting the existence of broad areas of structurally high but relatively undeformed salt in this region. Apronlike bottom contours (fig. 2) and thick Pleistocene sediments on the continental rise near Alaminos Canyon suggest that sediments have moved unimpeded across the slope owing to subdued topography of this region.

From drill-hole (Table 2) and reflection-profile data, Lehner (1969) reported that the synclinal basins on the slope primarily contain slump deposits most of which are mud, and noted that only a few turbidite sands were encountered in the drill holes. He estimated that some basins contain as much as 3,048 m (10,000 ft) of Pleistocene sediments, although core holes penetrated beds as old as Pliocene on the flanks of seven domes and Miocene to Eocene on two. Redbeds of unknown age lying above salt and beneath Upper Cretaceous pelagic shale and chalky ooze (Lehner, 1969) were discovered in drill holes on the crest of a large salt massif east of Brownsville. That few drill holes on the salt structures penetrated beds older than Pliocene led Lehner to conclude that Lower Tertiary and Mesozoic strata are generally thin or absent on the Texas-Louisiana slope.

Sediment Volume

The volume of sedimentary material above the assumed top of salt on the U.S. continental slope (fig. 5) has been determined from 4,830 thickness measurements spaced 5 km (3.1 mi) apart (Table 3). Each data point was considered representative of a 25 km^2 (9.6 mi^2) area. The area for which volumetric calculations were made encompasses 119,670 km^2 (46,013 mi^2) of which 8,531 km^2 (3,276 mi^2) lies in the region between the 200- and 600 m contours.

The sedimentary volume calculated from the accompanying isopach map is considerably less than previous estimates for the sediments on the slope. For example, Powell and Woodbury (1971) have estimated a volume of 215,850 km^3 (51,800 mi^3) for Pleistocene sediments of the continental slope between the West Florida platform on the east and lat 26° N. on the southwest. Their estimates were made for an area of 134,680 km^2 (52,000 mi^2) including a 15,010 km^2 (5,987 mi^2) area of slope in the northeastern Gulf not included in the present report, which thus considers approximately 88.5% of the area of Powell and Woodbury. Assuming an equal distribution of Pleistocene deposits on the northern

Gulf slope, 88.5% of their volume estimate would yield 45,843 mi^3 of sediments of Pleistocene age only on the Texas-Louisiana slope. This is considerably more than the total volume of sediments of all ages above salt calculated in this report. The primary reason for discrepancies in volume estimates for the Texas-Louisiana slope stems from the underestimation of the extent of salt diapirism on the slope by Powell and Woodbury. The results of this study indicate that enormous salt domes underlie the entire slope south of Louisiana and Texas at shallow subbottom depths. Synclinal basins between domes, although containing thick sections of sediment, are small in comparison to dome sizes. These factors combine to yield a smaller average sediment thickness than previously assumed.

References

Amery, G. B., 1969, Structure of Sigsbee scarp, Gulf of Mexico: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2480-2482.

Carsey, J. B., 1950, Geology of Gulf coastal area and continental shelf: Am. Assoc. Petroleum Geologists Bull., v. 34, no. 3, p. 361-385.

deJong, A., 1968, Stratigraphy of the Sigsbee scarp from a reflection survey (abs.): Soc. Exploration Geologists Prog., Fort Worth Mtg., p. 51.

Emery, K. O., and Uchupi, Elazár, 1972, Western North Atlantic Ocean: Topography, rocks, structure, water, life and sediments: Am. Assoc. Petroleum Geologists, Tulsa Mem. 17, 532 p.

Ewing, M., and Antoine, V. W., 1966, New seismic data concerning sediments and diapiric structures in Sigsbee Deep and continental slope, Gulf of Mexico: Am. Assoc. Petroleum Geologists Bull., v. 50, p. 479-504.

Garrison, L. E., and Berryhill, H. L., Jr., 1970, Possible seaward extension of the San Marcos Arch (abs.): Geol. Soc. America Abstracts with Programs, v. 2, no. 4, p. 285-286.

Garrison, L. E., and Martin, R. G., 1973, Geologic structures in the Gulf of Mexico basin: U.S. Geol. Survey Prof. Paper 773, in press.

Gealy, B. L., 1955, Topography of the continental slope in the northwest Gulf of Mexico: Geol. Soc. America Bull., v. 66, p. 203-228.

Lehner, P., 1969, Salt tectonics and Pleistocene stratigraphy on continental slope of northern Gulf of Mexico: Am. Assoc. Petroleum Geologists Bull., v. 53, p. 2431-2479.

Moore, D. G., and Curray, J. R., 1963, Structural framework of the continental terrace, northwest Gulf of Mexico: Jour. Geophys. Research, v. 68, p. 1725-1747.

Powell, L. C. and Woodbury, H. O., 1971, Possible future petroleum potential of Pleistocene, western gulf basin: in Cram, I. H. (ed), Future petroleum provinces of the United States - their geology and potential: Am. Assoc. Petroleum Geol. Mem. 15, v. 2, p. 813-823.

Shepard, F. P., 1937, Salt domes related to Mississippi submarine trough: Geol. Soc. America Bull., v. 48, p. 1349-1362.

Shepard, F. P., 1963, Submarine Geology: 2nd Ed., New York, Harper and Row, 557 p.

Table 1.--Conversion chart for calculating approximate sediment thickness on Texas-Louisiana slope. Modified after Lehner (1969).

Thickness in two-way reflection travel time (sec)	Assumed velocity for cumulative thickness interval (km/sec)	Sediment (m)	Thickness (ft)
1.0	1.894	947	3,110
2.0	2.170	2,170	7,120
3.0	2.480	3,723	12,215
4.0	2.697	5,394	17,700

Table 2.--Tabulated coring data from salt structures on Texas-Louisiana continental slope. From Lehner (1969).

Core Hole No.	Water Depth (m)	Water Depth (ft)	Sediment Penetration (m)	Sediment Penetration (ft)	Stratigraphic Summary
114A	288	(950)	133	(439)	Salt; anhydrite caprock; Pliocene-Pleistocene deep-water shale.
113	446	(1,472)	281	(928)	Upper Pliocene - Holocene clay.
115A	412	(1,361)	303	(1,000)	Upper Pliocene - Holocene clay.
122	597	(1,971)	245	(809)	Pleistocene clay.
123	529	(1,746)	192	(636)	Salt; Pleistocene deep-water shale.
59A	261	(861)	71	(235)	Salt; Pleistocene clay and sand (outer neritic and deep-water faunas).
80	572	(1,889)	92	(304)	Salt; Upper Eocene-Pleistocene clay and sand.
80A	520	(1,716)	302	(995)	Pleistocene-Holocene clay.
27	1,130	(3,730)	152	(501)	Salt; Pleistocene deep-water clay.
31	911	(3,005)	222	(732)	Salt; Pleistocene deep-water clay.
33	939	(3,100)	155	(510)	Salt; Pleistocene deep-water clay.
15A	864	(2,850)	264	(879)	Salt; Miocene-Holocene deep-water shales.
19E	1,091	(3,600)	171	(563)	Salt; turbidite sand; Pleistocene deep-water clay.
116	1,222	(4,034)	303	(1,000)	Pliocene-Pleistocene deep-water shales; turbidite sands.
118	1,415	(4,671)	223	(736)	Pleistocene deep-water clay; turbidite sands.
119	1,329	(4,387)	154	(507)	Pleistocene deep-water clay; turbidite sands.

Table 2.--Tabulated coring data from salt structures on Texas-Louisiana continental slope. From Lehner (1969)--Continued.

Core Hole No.	Water Depth (m)	Water Depth (ft)	Sediment Penetration (m)	Sediment Penetration (ft)	Stratigraphic Summary
125	1,599	(5,278)	290	(957)	Pliocene-Pleistocene deep-water clay.
40	758	(2,500)	178	(590)	Salt; redbeds; Eocene-Holocene clay.
40D	790	(2,606)	136	(449)	Redbeds; Upper Cretaceous-Tertiary shale.
40D'	790	(2,606)	155	(512)	Redbeds; Upper Cretaceous-Tertiary shale.
40C	910	(3,002)	303	(1,000)	Pliocene-Pleistocene clay.
40B'	1,020	(3,367)	92	(304)	Pleistocene clay and sand.
40B	1,032	(3,405)	49	(160)	Pleistocene-Holocene clay.

Table 3. Summary of sediment thickness and volume on Texas-Louisiana slope.

Region	Average Thickness based on sediment velocity of 2.0 km/sec			Area		Volume based on average thickness	
	(sec)	(m)	(ft)	(km^2)	(mi^2)	(km^3)	(mi^3)
Upper Slope (200-600 m):							
Louisiana	1.7	1,700	5,610	1,456	559	2,475	593
Texas	1.7	1,700	5,610	7,075	2,717	12,028	2,880
Total Upper Slope	1.7	1,700	5,610	8,531	3,276	14,503	3,473
Middle and Lower Slope (600-3,000 m):	1.4	1,400	4,620	111,139	42,737	155,594	37,395
TOTAL SLOPE (200-3,000 m):				119,670	46,013	170,097	40,868

Illustrations

Figure 1.--Location of seismic reflection profiles recorded on continental slope of northwest Gulf of Mexico aboard USNS *Kane* and *Keathley*, R/V *Cadette Virigilio Uribe*, and M/V *Unitedgeo I*. Contours in meters.

Figure 2.--Bottom contour chart, Texas-Louisiana slope. Bathymetry in meters; compiled by U.S. Naval Oceanographic Office.

Figure 3.--Structure contours on top of salt in seconds of reflection travel time.

Figure 4. Isopach map showing sediment thickness above top of salt in seconds of reflection travel time.

Figure 5. Regional salt structure and area of volumetric calculations for sediments above salt. Contours in meters.